INTERNATIONAL STANDARD

ISO 6966-2

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Aircraft ground equipment — Basic requirements —

Part 2: Safety requirements

Matériel au sol pour aéronefs — Exigences de base —

Partie 2: Exigences de sécurité

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 6966-2 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 9, *Air cargo and ground equipment*.

This first edition of ISO 6966-2, together with ISO 6966-1, cancels and replaces ISO 6966:1993, which has been technically revised.

ISO 6966 consists of the following parts, under the general title *Aircraft ground equipment — Basic requirements*:

— *Part 1: General design requirements*

— *Part 2: Safety requirements*

Introduction

This part of ISO 6966 specifies the safety requirements to be taken into account by manufacturers for the design of aircraft ground support equipment. It identifies the various concerns to be taken into consideration to ensure ground equipment safety for operators and aircraft.

Throughout this part of ISO 6966, the minimum essential criteria are identified by use of the key word “shall”. Recommended criteria are identified by use of the key word “should” and, while not mandatory, are considered to be of primary importance in providing safe, economical and usable aircraft ground support equipment. Deviation from recommended criteria should only occur after careful consideration and thorough service evaluation have shown alternative methods to provide an equivalent level of safety.

Aircraft ground equipment — Basic requirements —

Part 2:
Safety requirements

IMPORTANT — In most countries, standing government health and safety laws and regulations apply to machinery, implicitly or explicitly including aircraft ground support equipment. Nothing in this part of ISO 6966, however, shall be deemed or otherwise used to supersede any locally applicable law or regulation, unless a specific exemption has been obtained for this purpose from the appropriate authority.

1 Scope

This part of ISO 6966 specifies the minimum design requirements applicable to all aircraft ground support equipment, as defined in 3.1, in order to ensure

a) safety of staff operating or maintaining the equipment or in its vicinity;

b) protection of aircraft against interference or damage.

The requirements of this part of ISO 6966 apply to any piece of aircraft ground support equipment, as defined in 3.1, used on airports.

NOTE An informative list of the most commonly used pieces of ground equipment is provided in Annex A.

This part of ISO 6966 does not provide all the design requirements applicable for aircraft ground support equipment. Other requirements apply, and can be found in separate standards:

— ISO 6966-1 specifies the general, other than safety related, design requirements applicable to all aircraft ground support equipment;

— ISO 4116 specifies the additional requirements applicable for conveying surfaces of those pieces of aircraft ground support equipment intended for handling and loading of baggage and cargo unit load devices;

— specific standards, listed in the Bibliography, define the functional and performance requirements for certain types of aircraft ground support equipment.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 3411, *Earth-moving machinery — Human physical dimensions of operators and minimum operator space envelope*

ISO 3457, *Earth-moving machinery — Guards — Definitions and requirements*

ISO 3795, *Road vehicles, and tractors and machinery for agriculture and forestry — Determination of burning behaviour of interior materials*

ISO 3864 (all parts), *Graphical symbols — Safety colours and safety signs*

ISO 4116, *Air cargo equipment — Ground equipment requirements for compatibility with aircraft unit load devices*

ISO 6682, *Earth-moving machinery — Zones of comfort and reach for controls*

ISO 6966-1, *Aircraft ground equipment — Basic requirements — Part 1: General design requirements*

ISO 7000, *Graphical symbols for use on equipment — Index and synopsis*

ISO 11995:1996, *Aircraft — Stability requirements for loading and servicing equipment*

ISO 14122-3, *Safety of machinery — Permanent means of access to machinery — Part 3: Stairs, stepladders and guard-rails*

ECE 43, *Uniform provisions concerning the approval of safety glazing and glazing material* [1)]

ECE 79, *Uniform provisions concerning the approval of vehicles with regard to steering equipment* [1)]

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 6966-1 apply, some of which are reproduced below for the convenience of the user.

3.1
aircraft ground support equipment
GSE
ground equipment
ramp equipment
any piece of mobile equipment, whether or not powered or self-propelled, purpose designed, built and used for ground handling, servicing or field maintenance of civil transport aircraft on the ramp area of an airport

NOTE A non-comprehensive informative list of the most commonly used pieces of ground equipment is provided in Annex A.

3.2
ramp area
apron GB
zone of an airport where aircraft manœuvre and park for ground handling purposes

3.3
ramp
apron GB
tarmac US
surface of the ground in the ramp area

1) ECE 43 and 79 are part of the United Nations Economic Commission of Europe agreement concerning the adoption of uniform conditions of approval and reciprocal recognition of approval for motor vehicle equipment and parts, and can be obtained from any United Nations office.

4 Characteristics

4.1 General

4.1.1 Considerable importance is attached to having equipment into which the essential safety aspects have been incorporated as part of the basic design (design to safety). It is particularly necessary when designing aircraft ground support equipment (GSE) to take into account the adverse conditions which frequently prevail in ramp areas, e.g. congested vehicle movement, exposure to weather, night operation, noise from aircraft and other vehicles, and difficult communications.

4.1.2 Design to safety should be based on a specific comprehensive risk assessment for each type of aircraft GSE, to be conducted by the manufacturer. The retained design should be commensurate with the results of the risk assessment and should take into account, if applicable, each area of potential concern listed in Clause 4.

4.1.3 Design should aim at providing intrinsically safe equipment, i.e. where potentially unsafe occurrences are prevented by basic design features such as equipment and component geometry, layout, or mode of operation, minimizing inasmuch as feasible the necessity to use additive safety devices or circuits. Where such additional devices or circuits dedicated to safety purposes cannot be avoided, risk assessment shall include an evaluation of any potential drawbacks or unforeseen additional hazards resulting from this addition.

4.1.4 All equipment or any component thereof, the failure of which could be hazardous, shall be designed to be fail-safe, or, where impractical, duplicated. In the event of duplication, each of the duplicated components shall separately be capable of safely performing its function in the event of failure of its duplicate.

4.1.5 The content of this part of ISO 6966 was determined by taking into account generally recognized assumptions with regard to

a) the normally intended use of aircraft GSE, when used on the ramp of international civil airports in order to handle, service or maintain civil transport aircraft;

b) the environmental (surface, slope, weather, lighting, operating rules, staff qualification, etc.) conditions prevailing on the ramp area of the majority of international civil airports.

Manufacturers of aircraft GSE should define in the relevant documentation (see Clause 6) the specifically intended conditions of use and environment for each item of equipment, and purchasers systematically review their own specific conditions of use and environment in order to determine whether those stated are adequate, or negotiate with the manufacturer appropriate modifications to ensure they are.

NOTE For intended operation in Europe, additional EU Machinery Directive requirements also apply. They can be met by complying with the requirements of the following European standards.

EN 1915-1, *Aircraft ground support equipment — General requirements — Part 1: Basic safety requirements*

EN 1915-2, *Aircraft ground support equipment — General requirements — Part 2: Stability and strength requirements, calculations and test methods*

EN 1915-3, *Aircraft ground support equipment — General requirements — Part 3: Vibration measurement methods and reduction*

EN 1915-4, *Aircraft ground support equipment — General requirements — Part 4: Noise measurement methods and reduction*

4.2 Personnel accommodation

4.2.1 Personnel working surfaces

4.2.1.1 All personnel working surfaces, including work platforms, walkways, steps, landings and crossings, as well as stairs, ramps, ladder rungs, cleats or treads, shall be self-draining and have a high-traction (non-slip) surface.

4.2.1.2 Walkways shall have a minimum width of 0,4 m (16 in), except on unit load device conveying surfaces where they shall have a minimum width of 0,3 m (12 in). Standing areas and landings shall have minimum dimensions of 0,4 m × 0,5 m (16 in × 20 in).

4.2.1.3 Ladder and stair treads shall be designed to support a minimum load of 890 N (200 lb). Landings and all personnel working surfaces shall be designed to support a minimum load of 1 100 N (250 lb) for each person occupying said landing and/or working surface at the same time, and withstand a minimum distributed load of 3 000 $N \cdot m^{-2}$ (63 lb/ft^2) over their whole surface.

4.2.1.4 All operational personnel work platforms and walkways where there is a possibility of falling from heights in excess of 1,0 m (40 in) shall have guardrails with a minimum height of 1,1 m (43 in) in accordance with ISO 14122-3, including the following:

— a handrail;

— a kick plate (toe board) with a minimum height of 0,1 m (4 in);

— at least one knee rail, located no more than 0,5 m (20 in) above the kick plate.

4.2.1.5 On vehicles with an open cabin with passenger seat(s), a hip guard shall be provided on the outside edge of the outer seat(s), with a minimum height of 80 mm (3 in) above the seat surface.

4.2.1.6 Where ladders are used for access, the incline angle shall not be less than 75°, with a maximum of 90°. Where stairs are used, the incline angle shall not be less than 20°, with a maximum of 50°. Equal spacing between rungs or steps, not to exceed 0,3 m (12 in), shall be maintained above the first one. Steps shall have a minimum depth of 80 mm (3 in). Rungs shall have a minimum diameter of 20 mm (0,8 in). A minimum 150 mm (6 in) clearance shall be maintained from any obstruction, including between parallel elements of a telescopic ladder or stair.

4.2.2 Driver/operator cabin

Where a cabin is provided, the minimum size of the driver's or operator's space envelope shall conform to the requirements of ISO 3411. For seated accommodation, individual restraint systems (safety belts) should be provided in accordance with locally applicable regulations.

Where transport of persons other than the driver/operator is specified, the GSE shall be equipped with

— seats, with restraint system when located in the outer position directly behind the windshield, or

— standing accommodation with appropriate handholds.

All glass in doors and windows shall be safety glass meeting the requirements of ECE 43, or alternative material (e.g. polycarbonate) with at least the same performance characteristics. The windshield and all windows considered to be important for the driver's field of view when travelling shall be transparent and as distortion-free as possible.

When selecting driver or operator seats, consideration should be given to

— providing adjustment if required to maintain ergonomic access to controls regardless of the person's size;

— protection against the vibrations encountered during vehicle travelling or operation.

The floor, upholstery and insulation of enclosed cabins shall consist of flame retardant material that has a horizontal burning rate not greater than 250 mm (10 in) per minute in accordance with ISO 3795.

The inside of the cabin shall not include any sharp edges or protrusions. All corners and edges shall be chamfered or rounded with a minimum radius of 3 mm (0,1 in).

4.2.3 Visibility

4.2.3.1 Vehicle drivers and operators shall have clear and unimpaired visibility when operating the unit. The shape and arrangement of any driver's or operator's cabin shall not restrict the field of view for travel or operation. There shall at least be mirrors designed and fitted in such a way that the driver is able to observe the rear sideward areas.

4.2.3.2 Any vehicle equipped with a windshield shall be provided with a powered windshield wiper giving a wipe area of not less than 60 % of the glazed area. A sun visor of suitable size shall be provided. Overhead view panels should also be fitted with wiping mechanisms.

4.2.3.3 On vehicles equipped with an enclosed cabin, the windshield shall be provided with a defogger and/or defroster.

4.2.3.4 Lighting shall be arranged in such a way that no disturbing dazzling effect is caused in conjunction with the windshield and other windows that are in the driver's field of view.

4.2.3.5 Passive visibility of the vehicle shall be enhanced by reflective material or, preferably, fluorescent paint being applied on all its outer corners, using safety colours in accordance with ISO 3864.

4.2.4 Controls, monitoring devices and displays

4.2.4.1 Controls and warning lights shall be grouped and located so as to be convenient to the operator from his normal operating station or stations, within his reach in accordance with ISO 6682. All control device actuators shall be constructed and mounted so as to minimize the risk of inadvertent operation.

4.2.4.2 Where there is more than one station, interlocks should be provided at each station to render inoperative the controls of all other stations.

4.2.4.3 Controls and warning lights shall be properly and permanently identified, preferably by pictograms in accordance with ISO 7000.

NOTE Graphical symbols for use on aircraft ground equipment will form the subject of a future International Standard (ISO 11532).

4.2.4.4 Controls and controlling circuits shall be designed in such a manner that failure within a control or its circuitry will not introduce an unsafe operating condition.

4.2.4.5 All operational controls shall move in the direction of travel for the function which they control, and shall be designed so that when they have been released, the energy initiating the controlled movement is cut off ("hold-to-run" or "dead man" type), unless the control is set to achieve a function to permit the user to accomplish another task. In this case, such set controls shall be detented or similarly locked into the operating position to prevent inadvertent deactivation or reversing. Such controls shall be readily available to the operator(s). Operating controls used only in emergencies need not meet this requirement.

As an exception, the transmission shift lever sequence on automatic transmissions of vehicles to be exclusively operated at North American (USA, Canada, Mexico) airports may conform to local highway vehicle practice with a shift position sequence P, R, N, D, L starting from the front of the vehicle.

4.2.4.6 On–off switches shall be "on" in the up position, or away from the operator if mounted on a horizontal plane.

4.2.4.7 Hand and foot controls, including those for driving purposes, shall be sized and spaced to provide easy operation with a gloved hand and/or booted foot dependent on the control. Consideration shall be given to environmental weather conditions in which the unit will operate. Furthermore,

— hand control actuation shall not require a force of more than 100 N (22 lb);

— foot controls shall be a minimum of 50 mm × 80 mm (2 in × 3 in) and provided with a non-slip surface material, and their actuation shall not require a force of more than 300 N (66 lb).

4.2.4.8 Illumination of control panels, monitoring devices and displays shall ensure a minimum of 50 lx (5 fc), and be of anti-glare and non-reflecting quality.

4.2.4.9 Conventional automotive driving controls shall be used whenever possible.

4.3 Stability and strength

4.3.1 Stability

4.3.1.1 Lifting type units exposed to jet blast, wind and/or irregular surfaces shall be equipped with stabilizing devices which preclude the unit overturning when exposed to

a) wind or blast up to 75 $km \cdot h^{-1}$ (40 kn) with all the static parameters in the worst-case conditions (most unfavourable load, ramp slope, etc. conditions in fully erected position) defined by ISO 11995:1996, 4.3 a);

b) wind or blast between 75 $km \cdot h^{-1}$ (40 kn) and 120 $km \cdot h^{-1}$ (65 kn), subject to appropriate operating constraints and precautions to be determined and implemented by the operator, as per ISO 11995:1996, 4.3 b).

Stability shall be calculated in accordance with ISO 11995:1996.

4.3.1.2 Self-propelled type units equipped with power actuated stabilizers shall have an operator warning device to indicate when the stabilizers are not in the stowed position.

4.3.1.3 The stability outlined in 4.3.1.1 shall determine at which point during elevation the stabilizing devices will be necessary. A safety device shall be provided to ensure this elevation is not exceeded unless stabilizing devices are extended and/or engaged. Retraction of the stabilizing devices shall not be possible under normal or emergency conditions until the unit has been lowered to within the stability requirement outlined in 4.3.1.1.

4.3.1.4 Stabilizer design shall meet the following requirements:

a) stabilizer activating devices shall be located so as not to expose the operator to personal injury;

b) an interlock shall be provided to prevent driving the vehicle when stabilizers are not fully retracted;

c) stabilizers shall not collapse in the event of a system failure;

d) stabilizers shall be secured against unintentional shifts in both the extended and retracted positions by means of a positive restraint device;

e) stabilizers shall be marked with black and yellow reflective tape, and stabilizer pads shall be painted red, using safety colours in accordance with ISO 3864.

4.3.1.5 The stabilizers in the retracted position shall not protrude beyond the overall width of the vehicle. Whenever possible, neither should they protrude beyond this overall width when in the extended position.

4.3.2 Strength

4.3.2.1 GSE shall be designed and built so that its mechanical strength is ensured during intended use. Strength calculations shall be based on the most unfavourable combination of equipment position, rated load, local and snow loads, dynamic forces and wind conditions, in accordance with either

— recognized engineering design methods and codes of practice;

— finite element analysis;

— actual testing and stress measurement; or

— combinations of these, commensurate with the type of GSE concerned.

4.3.2.2 The general stress analysis shall be carried out to ensure safe levels of stress in relation to the yield stress of the materials used. In addition to the most unfavourable combination defined in 4.3.2.1, dynamic forces, including consideration of the high dynamic forces which can be caused by the operation of a safety device for the prevention of unintentional movements, and significant effects of elastic deflection shall be taken into account.

4.3.2.3 The stress factors used to determine acceptable yield stress ratios shall be stated, consistent with the materials, assembly techniques (e.g. welding) and calculation methods used and all the requirements of locally applicable regulations or national standards.

4.3.2.4 A fatigue calculation shall be carried out, taking into account the intended load spectrum (average load and number of cycles) throughout the expected life of the GSE.

4.3.2.5 The rated load taken into account in stress calculations for each area capable of supporting a load shall be stated, and shall not be less than 3 000 $N \cdot m^{-2}$ (63 lb/ft^2).

4.3.2.6 Where a standard automotive chassis is used, appropriate gross weight rating shall be determined based on chassis manufacturer's allowances, vehicle intended use, and any maximum speed limitation per construction.

4.3.3 Lifting systems

4.3.3.1 All lifting systems shall be so designed and equipped that failure in any element of the lifting mechanism does not result in uncontrolled descent or hazardous movement of the lifting platform. Where self-lowering is acceptable in the event of a failure, the lowering speed shall not exceed 1,5 times the maximum rated lifting speed. Where protection is achieved by limiting the possible fall range of the platform, this shall not exceed 100 mm (4 in), and any platform tilting shall not exceed 5°.

4.3.3.2 Elements used as safety devices against unintentional lowering shall be independent of the regular lifting elements and shall remain unloaded during usual operation. They shall be functional in all positions of the lifting platform. If overrideable after they have tripped, this shall be only in order to move the platform into the lowered position, and they shall become operative again automatically.

4.3.3.3 Where a lifting system has two or more lifting elements in parallel, they shall be designed so that the loads resulting from failure of one element shall not have effects jeopardizing safety.

NOTE For calculation purposes, this situation can be considered as exceptional loading.

4.3.3.4 The safety factors used to determine acceptable stress and pressure levels in lifting elements, including chains, wire ropes, mechanical and hydraulic elements, shall be stated, consistent with the techniques used and all the requirements of locally applicable regulations or national standards.

4.3.3.5 Maintenance supports painted in a safety colour in accordance with ISO 3864 shall be provided to secure the raised platform(s) or other lifting element(s) in order to protect maintenance staff working underneath against the risk of lowering.

4.4 Components

4.4.1 All GSE cabin or access doors and panels shall be provided with securing devices to retain them in the open and/or closed position. They shall be capable of withstanding jet blast or ambient winds as specified in 4.3.1.1, and shall be installed so that the doors, when open, do not create a personnel injury hazard.

4.4.2 It shall be possible to positively secure all movable elements (doors, covers, access panels, tilting or lifting bodies, adjustable guardrail parts, etc.) in selected positions by means of mechanical restraint or friction type devices. Fixed mechanical stop devices shall prevent movement farther than the designed end positions.

4.4.3 All components that exceed a mass of 36 kg (80 lb), or that exceed a mass of 15 kg (33 lb) where only one person has access to the unit for handling, shall have provisions for attaching lifting or handling devices.

4.4.4 Internal combustion engines shall be fitted with a baffle type muffler. The exhaust system, beyond the manifold, shall be supported at least 75 mm (3 in) clear of any combustible material, excluding flexible mountings, and at least 50 mm (2 in) clear of any fuel, hydraulic and electrical system parts, and shall not be subject to dripping of fuel, oil or grease.

4.5 Personnel protection

4.5.1 All potential nip or pinch hazard points (sprockets, gears, chains, belts, fans, pulleys, etc.) which are not protected by vehicle structures or covers shall be guarded in accordance with ISO 3457.

4.5.2 Access to all potential crushing and shearing hazard points should be prevented by design. If this is not possible, they shall be protected as specified in 4.5.1 or, if they occur under lifting equipment, other safety measures shall be provided to reduce the risk of injury to persons resulting from the lifting equipment.

NOTE Such measures can include, but are not limited to, flexible mounted guards extending to the outside edge of the GSE with hatching of the guards or the crushing and shearing points in safety colours in accordance with ISO 3864, and/or a reduced lowering speed, flashing warning light, audible warning signals, dedicated emergency stops, etc.

4.5.3 The discharge of exhaust systems shall be located so that it will not expose personnel to injury. The surface of exhaust systems or any other hot surfaces reachable from work areas, walkways or ground shall be guarded if their temperature exposes personnel to a risk of burn.

4.5.4 Devices for towing GSE or aircraft shall be of rigid construction and positively secured against unintentional disconnection by means of a mechanical restraint device. Furthermore,

a) tongues, tow bars and draw bars shall be designed to minimize exposure to pinch points during coupling;

b) tow bars and drawbars stored in the vertical position shall be securable by a mechanical restraint device;

c) a stop shall be provided to prevent the tow bar from coming into contact with the ground when dropped. The ground clearance of the eye shall be at least 120 mm (5 in);

d) the towing eye and the tow bar shall be made clearly visible in poor lighting conditions in order to avoid accidents, using safety colours in accordance with ISO 3864.

4.5.5 Means shall be provided to secure all loads, loose parts or accessories against hazardous movement when travelling or operating, and to safely store any load securing equipment (e.g. ropes, straps, chocks) carried.

4.6 Aircraft protection

4.6.1 Any part of the GSE coming close to or liable to touch the aircraft shall have suitable protective padding.

NOTE Typical padding practices are covered by SAE ARP 1558A (see Bibliography item [20]).

4.6.2 A positively controlled, non-jerking, slow speed is required for the final positioning of GSE to the aircraft.

4.6.3 Where a lifting element may project or be moved beyond the outer limit of the GSE, or has to keep within a specified working height relative to the aircraft, any unintentional movement shall be prevented if there is a leakage in the hydraulic system or a failure of a lifting element. An interlock shall be provided so that intentional lowering is possible only after the projected element has been retracted.

4.7 Systems

4.7.1 Fuel system

4.7.1.1 Fuel lines shall be constructed of steel or seamless annealed copper tubing. Flexible fuel lines produced to the relevant performance standard may also be used, to assist with routing, ease of maintenance, and where it is necessary to absorb vibration and prevent fatigue. Fuel lines shall be secured with a minimum 50 mm (2 in) clearance to exhaust and electrical systems. In the case of flexible fuel lines, additional clearance shall be provided around exhaust or any other heat-producing components.

4.7.1.2 Fuel tank(s) and lines shall be located and installed so that any overflow during filling, or any leakage from the tank, lines or fittings will not impinge on the engine, exhaust, electrical system or other ignition sources or enter the operator's compartment. Consideration should be given to avoiding spilled fuel making work or access surfaces slippery.

4.7.1.3 Fuel tanks shall be located for maximum protection from collision damage.

4.7.2 Hydraulic system

4.7.2.1 Pressure-limiting valves shall ensure that pressurized pipes in GSE hydraulic systems are not subjected to more than 1,4 times the static pressure at the maximum permissible operating load. Pressure limiting valves shall be safeguarded against tampering by unauthorized persons.

4.7.2.2 Hydraulic hoses shall be installed and fixed in such a way that damage by crushing, abrasion, heating up, twisting, etc. is avoided, and, in the case of potential leakage, protection shields shall be installed to prevent fluid coming into contact with the exhaust or any other heat-producing components. Hydraulic hoses with an operating pressure of more than 15 MPa (2 175 psi) shall not have reusable end fittings.

4.7.2.3 Hydraulic hoses in the working or access areas of GSE containing fluid at a pressure exceeding 5 MPa (725 psi) and/or a temperature exceeding 50 °C (120 °F) shall have covers as specified in ISO 3457.

4.7.2.4 Hydraulic systems where hydraulic fluid contamination could lead to hazardous operating conditions, e.g. on lifting devices or hydrostatic drives, shall be equipped with filters which have an easy-to-read contamination indicator.

4.7.3 Electrical system

4.7.3.1 Electrical wires, components and conductors shall be installed in such a way as to avoid wear and tear and exposure to environmental conditions which could cause deterioration. The protective conductor of any electrical systems shall be connected to the chassis. Electrical components located in areas directly exposed to weather shall be protected, to a degree to be determined based on risk assessment. Electrical interlocks shall be of fail-safe design, of a category to be determined by risk assessment.

NOTE 4.7.3.1 does not apply to an automotive chassis meeting applicable road traffic regulations.

4.7.3.2 Batteries shall be positioned and secured to prevent mechanical damage. Battery housings shall be fire resistant. Suitable ventilation openings shall be provided in the battery container, compartment or cover so that dangerous accumulations of gases do not occur during GSE intended use.

4.7.3.3 Batteries and/or battery locations shall be designed and built or covered so that there is no risk to the operator from battery acid or vapours, even in the case of overturning of the GSE.

4.7.3.4 Battery terminals shall be protected against inadvertent contact, e.g. by insulating covers and shrouds. An easily accessible battery disconnecting switch of appropriate nominal capacity shall be fitted close to the batteries.

4.7.3.5 Any external battery connectors, e.g. for recharging purposes, shall be safely stowed and marked with a safety colour in accordance with ISO 3864.

4.8 Mobility

4.8.1 Operating speeds

4.8.1.1 The travelling speed of GSE shall be limited to a maximum of 6 $km \cdot h^{-1}$ (4 mph) by design

a) during pedestrian controlled operation, directly or through a cable link;

b) whenever a lifting platform or basket has been moved over the resting position.

Consideration should be given to limiting by construction maximum speed to that allowed on the ramp area and service roads of the airport of use.

4.8.1.2 The movement speed of lifting/work platforms in any direction, vertical or horizontal, shall not exceed

a) 0,2 $m \cdot s^{-1}$ (0,67 ft/s) for single speed movements;

b) 0,4 $m \cdot s^{-1}$ (1,33 ft/s) for dual speed movements (with starting and stopping at reduced speed);

c) 0,6 $m \cdot s^{-1}$ (2 ft/s) for proportionally controlled movements with smooth, non-jerking starting and stopping.

4.8.1.3 The conveying speed for unit load devices should not exceed 0,3 $m \cdot s^{-1}$ (1 ft/s), and shall never exceed 0,6 $m \cdot s^{-1}$ (2 ft/s).

4.8.2 Braking

4.8.2.1 The service brake system shall safely stop vehicles under empty and full load conditions, and shall meet all locally applicable requirements and regulations, or at least the minimum values in Table 1 with the vehicle under maximum allowed load braking from a speed of 30 $km \cdot h^{-1}$ (19 mph):

Table 1 — Service brake system

Requirement	Vehicle gross mass range		
	less than 2 250 kg (5 000 lb)	**2 250 to 4 500 kg** (5 000 to 10 000 lb)	**over 4 500 kg** (10 000 lb)
Maximum stopping distance	7,5 m (25 ft)	9,0 m (30 ft)	12,0 m (40 ft)

4.8.2.2 The parking/emergency brake shall restrain the vehicle when fully loaded on an incline of 3° (5 %), or more if specified by locally applicable requirements or regulations.

4.8.2.3 In the case of GSE, the function of which is towing other equipment, the vehicle's service and parking brake efficiencies should be increased in accordance with the maximum allowed towed load. The maximum allowed stopping distance of a towed train of unbraked trailers with maximum allowed load shall be 30 m (100 ft).

4.8.2.4 Non self-propelled GSE shall have either a parking brake or equivalent means (e.g. chocks) capable of restraining it on an incline of 8° (15 %) or under the maximum blast or wind velocity specified in 4.3.1.1.

4.8.3 Steering

4.8.3.1 The steering system's design shall meet the locally applicable requirements and regulations, or at least the requirements of ECE 79.

4.8.3.2 GSE capable of a driving speed in excess of 25 $km \cdot h^{-1}$ (15 mp/h) shall have a dual-circuit power steering system.

4.8.4 Engine operation

4.8.4.1 For self-propelled vehicles, it shall not be possible to start the engine unless the shifting lever is in the neutral or park position.

4.8.4.2 For self-propelled equipment with a hand throttle, it shall not be possible to engage the forward or reverse gear unless the hand throttle is in the idle position.

4.8.4.3 Where the equipment includes an engine power take-off (PTO), interlocks shall be provided so that

a) the PTO cannot be engaged unless the vehicle's gear selection is in the parking or neutral position and the parking brake is set, or

b) engine revolution rate cannot increase while the PTO is engaged, unless the vehicle's gear selection is in the parking or neutral position and the parking brake is set.

4.9 Emergency systems

4.9.1 Emergency stop devices

4.9.1.1 Emergency stop buttons (red mushroom type on yellow background; safety colours in accordance with ISO 3846 shall be used) shall be provided on powered GSE. These should be installed at convenient positions on the unit to enable immediate shutdown in the event of an emergency. At least one of these should be accessible from outside the equipment at ground level.

4.9.1.2 Actuation of an emergency stop button shall inhibit all equipment functions, except emergency retraction and lowering (see 4.9.2). Cancelling the emergency stop command should be possible only by deliberate action.

NOTE Such deliberate action can, optionally, be by the use of a key available only to authorized personnel.

4.9.2 Emergency lowering

4.9.2.1 In an emergency situation, it shall be possible to retract, if applicable, and lower any lifting element of the GSE by means of an emergency lowering system activated by a power source independent from the main engine.

4.9.2.2 The controls for emergency retraction/lowering shall be clearly marked and easily accessible, at least from ground level.

4.9.2.3 In addition, means shall be provided to enable emergency towing away from the aircraft with the GSE's main source of power being unavailable, including for example towing eyes or a stowed tow bar, and a by-pass system on hydrostatic drives.

4.9.3 Fire prevention

4.9.3.1 A fire extinguisher of suitable type and capacity shall be provided on any self-powered equipment.

4.9.3.2 Where the GSE's intended use includes being allowed to operate in an aircraft's fire safety perimeter while aircraft refuelling is in progress, the following additional fire protection requirements shall be met:

a) a readily accessible engine stop device, spark proof in the event of an electrically powered GSE;

b) a spark arrestor or equivalent device in the exhaust of any internal combustion engine, able to prevent the emission of sparks or ignited particles.

5 Markings

5.1 A name plate shall be securely (e.g. riveted, welded) fastened on all GSE, and include the following legibly and permanently marked data:

— name and address of manufacturer;

— year of manufacture;

— type and serial number;

— unladen mass;

— maximum driving total mass, if the GSE is designed for transportation of persons or load;

— any marking or data legally required in accordance with locally applicable regulations.

5.2 In addition, the following safety related warnings shall be visibly and permanently marked at prominent relevant locations on the GSE, if applicable:

— maximum allowed travelling speed (if the GSE can exceed it);

— maximum allowed wind velocity (if the GSE presents a stability hazard);

— maximum payload or maximum number of persons;

— tyre pressure (if GSE is equipped with pneumatic tyres);

— maximum ground pressure of stabilizers (if the GSE is equipped with such);

— any safety related operating instructions specific to the GSE concerned.

5.3 The following hazards shall be identified by safety markings using safety colours in accordance with ISO 3864 and/or pictograms in accordance with ISO 7000:

— passive outer visibility (see 4.2.3.5);

— stabilizers [see 4.3.1.4 e)];

— maintenance supports for lifting equipment (see 4.3.3.5);

— towing eyes and tow bars [see 4.5.4 d)];

— battery connectors (see 4.7.3.5);

— power take-off (see 4.8.4.3);

— emergency stops (see 4.9.1.1);

— emergency lowering controls (see 4.9.2.2);

— emergency towing equipment (see 4.9.2.3);

— any area where standing is prohibited;

— any other specific hazard at a given location.

NOTE Graphical symbols for use on aircraft ground equipment will form the subject of a future International Standard (ISO 11532).

5.4 All fluid replenishment points shall be colour coded according to ISO 6966-1:2005, 6.6.2.

6 Manufacturer's instructions

6.1 Operating and maintenance instructions shall be established by the manufacturer and supplied with each GSE.

6.2 The operating instructions shall state the intended conditions of use of the GSE (see 4.1.5), including where they have been modified as a result of negotiation with the purchaser. The conditions of use shall include, where applicable, the allowable wind velocities, payload distribution, snow loads, ground slopes, ground pressures and fatigue load spectrum, and special instructions (e.g. as to electromagnetic interference) related to any remote control devices.

7 Quality assurance

7.1 Where contractually agreed, the manufacturer should deliver the GSE unit, together with a certificate of compliance with the requirements of this part of ISO 6966 and/or locally applicable government health and safety laws and regulations.

7.2 This certificate of compliance should be based on the design, building, control and testing according to applicable or contractually agreed standards of the GSE prior to delivery being performed within the framework of an appropriate manufacturer quality control programme (see Bibliography).